Structure and Motion Study Guide/Notes

Structure:

Center of gravity – the average position of all the weight on the robot

Support polygon – the shape created when you connect all the points where the robot touches the ground

Stability – the robot will be stable (won't fall over) if the center of gravity falls within the support polygon. The robot will be unstable (will fall over easily) if the center of gravity falls outside the support polygon.

Look at the example of the Towerbot that falls over backward when going up a ramp. Know at least one way to fix the problem

Look at the Grabberbot that falls over when it picks up a heavy object. Know at least one way to fix this problem.

Motion:

Motor – a device that turns electrical energy into mechanical energy

Standard motor modules spin 360 degrees in either a clockwise or counter clockwise direction

Servo Motor modules – have a limited range of motion (120 degrees). This is useful when operating an arm. You would not want the arm to spin in circles!

A motor can generate a set amount of power. This power can be used for **speed** or **torque**.
Speed is the **rate** at which the motor can turn the wheel (how fast)
Torque is the **force** with which the motor turns the wheel

Gears can help the motor increase the speed, torque or direction that the wheel turns.
The gear attached to the motor is the **driving gear** while the gear being turned by that gear is the **driven gear**.
To determine if the gears help with speed or torque you need to calculate the **gear ratio.**
Gear ratio is calculated by counting the number of teeth on the driving gear and the driven gear. Divide the driven gear by the driving gear to get the gear ratio.

Example:

If the driving gear has 36 teeth and the driven gear has 12 teeth than the gear ratio is

12:36 or 1/3

The gear ratio multiplies torque and divides speed, so

Torque times 1/3 means the force on the wheels would be decreased with this gear configuration.

Speed divided by 1/3 means the speed would be increased with this gear configuration.

A simple way to remember it is if the gear ratio is a number smaller than one, then the speed will be increased but the torque will decrease.

If the gear ratio is a number larger than one than the torque will be increased and the speed will be decreased.

Wheels size: If two robots are geared the same and have identical motors than the robot with the larger wheels will be faster than the one with smaller wheels. If you think about this, the wheels will turn the same number of times per minute, but the larger wheels have a larger circumference and so will cover more ground than the smaller ones.

Batteries:

Batteries work by storing energy in the form of electrons (particles with a negative charge) on the negative side of the battery. When you complete a circuit or pathway from the negative side to the positive side the electrons move from negative to positive and create electricity. When all the extra electrons have moved from the negative to the positive side, the battery is dead. To recharge it , we use electricity to move the electrons from the positive side back to the negative side.